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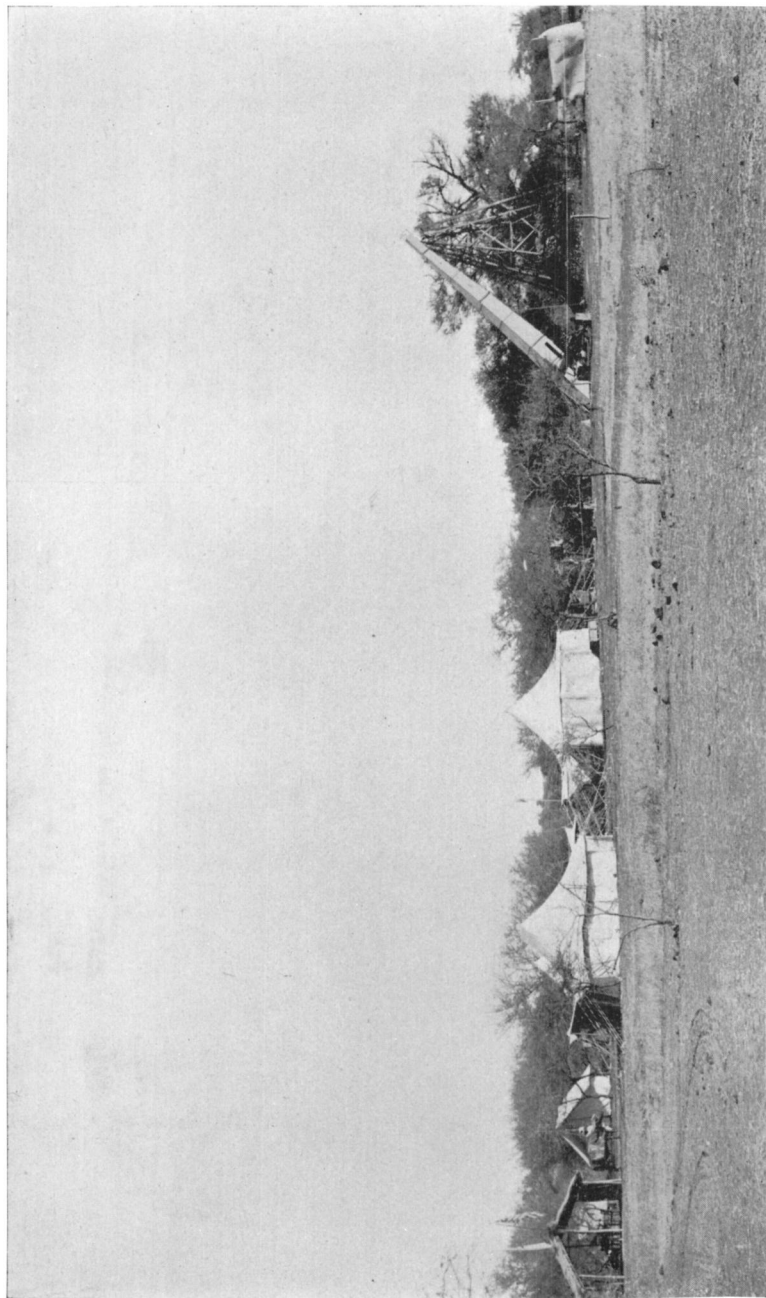
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GENERAL VIEW OF THE LICK OBSERVATORY ECLIPSE CAMP, NEAR JEUR, INDIA, JANUARY 22, 1898.

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A GENERAL ACCOUNT OF THE LICK OBSERVATORY-
CROCKER ECLIPSE EXPEDITION TO INDIA.

BY W. W. CAMPBELL.

The editor of this journal having requested me to furnish an account of the recent Lick Observatory Eclipse Expedition to India, I am glad to comply, on the understanding that no attempt shall be made to include the scientific results. While the expedition met with abundant success, the photographs have not yet been studied in the least. With practically every summer night clear for current observational work, the critical investigation of the eclipse plates must await the cloudy winter weather.

It has been the policy of the Lick Observatory to send out members of its staff to secure observations on the Sun's outer portions during all the available total solar eclipses. The eclipse of January 1, 1889, was observed in northern California by Messrs. KEELER, BARNARD, HILL, and LEUSCHNER; that of December 22, 1889, was observed at Cayenne, French Guiana, by Messrs. BURNHAM and SCHAEBERLE; that of April 16, 1893, was observed at Mina Bronces, Chile, by Professor SCHAEBERLE, and his volunteer assistants from many parts of the world. The Lick Observatory Expedition sent in Professor SCHAEBERLE's charge to observe the eclipse of August 9, 1896, in Japan, occupied four stations, but clouds obscured the Sun at all the stations.

The eclipse of January 22, 1898, began at sunrise in central Africa. The path of the shadow moved eastward to the Indian Ocean, thence inclining toward the northeast across India, ending

at sunset in Mongolia. The duration of totality was longest in the Indian Ocean, $2^m 20^s$. It decreased slowly from about $2^m 5^s$ on the west coast of India to about $1^m 20^s$ on the northeastern frontier of that country. The most available points for observations were in western India, with Bombay as the port of entry and base of supplies. Not only was this region the most accessible from the well-established routes of travel, but, what is more important, the astronomical conditions were the most favorable. The altitude of the Sun would be the greatest, from 50° to 52° , and there was the least probability of interference from clouds. January is in the "dry season" of India. The splendid report on the meteorology of the eclipse path prepared by the English Government in India showed that the weather in western India in January is very much like our beautifully clear weather on Mt. Hamilton in July and August. That eclipse parties would be favored with clear skies was almost a certainty. In view of these facts, it was not considered that the great distance—half-way around the globe—was an element in the question of sending an expedition to that country.

The late Colonel C. F. CROCKER, who had so generously defrayed the expenses of the earlier expeditions to Cayenne and Japan, expressed his interest in keeping up this line of work, and his willingness to provide means not only to send the expedition to India, but also for securing a substitute at Lick Observatory for the absent astronomer. This magnificent offer was made only a few days before his untimely death. The Board of Regents, of which Colonel CROCKER was a member, accepted the offer with gratitude, and authorized me to proceed to India and establish a suitable observing-station.

It was thought best not to interrupt my regular work of determining stellar velocities in the line of sight; and as my substitute to carry on that work did not arrive until toward the middle of August, there remained but two months in which to make preparations. Professor HOLDEN kindly placed the instrumental and mechanical resources of the Observatory at my disposal, so far as they could be spared. Deficiencies in our equipment were generously filled in by loans from friends of the Observatory. Thus the excellent Dallmeyer portrait-lens used at previous eclipses was again placed at our disposal by the Hon. WILLIAM M. PIERSON. Princeton University, through Professor YOUNG, loaned us its train of four compound prisms

and several minor pieces of apparatus. Aside from the clock in the 6-inch equatorial mounting, the Observatory could not well spare other driving-clocks. Two additional ones were imperatively needed, and they were supplied by loans from Professor HUSSEY and Mr. L. C. MASTEN. To save time, the four new spectrographs designed by me for the use of the expedition were mounted in wood (Spanish cedar) from my drawings, by the Observatory carpenter. In transit to India *via* Singapore and Colombo, these wooden mountings passed through a climate so moist and hot that it resembled a steam-bath. In India they were exposed for six weeks to the direct rays of the blazing sun, and to a remarkably dry atmosphere. That they worked satisfactorily is due to the quality of the wood and the excellent workmanship of the carpenter.

The experience of Professor SCHAEFERLE in Chile left no doubt in my mind that there would be an abundance of willing and able volunteer assistants in India to man all the instruments I could take with me. It was decided to take nine instruments, all for photographic use, as follows:—

A.—Three spectrographs for recording the spectrum of the Sun's edge, continuously, for a few seconds at the beginning of totality, and a few seconds at the end of totality, by means of plate-holders moving at a uniform rate by clockwork. This was a process which I had invented for use at the Japan eclipse, but personal reasons prevented me from taking that trip. As it was not known how bright the spectrum of the Sun's edge would be, I devised three instruments, whose proportions were such that the resulting intensities of their spectra would be very different, hoping that if one instrument under-exposed the spectrum, another would give the proper exposure. Two of these instruments were mounted on the 6-inch equatorial mounting, and the third on a large "polar axis."

B.—A spectrograph for recording the bright coronal line 1474 K, using light from the equatorial region of the corona both east and west of the Sun, to determine the displacement of the bright line due to motion in the line of sight, and thence to determine the law of rotation of the corona. Previous attempts to solve this problem made use of the violet calcium lines H and K; but as there was good reason to believe that those lines were not coronal, I decided to use the 1474 K line, which, to a great extent at least, is truly coronal. This line lies in a part of the

spectrum for which photographic plates are not very sensitive. Furthermore, to secure the dispersion sufficient for solving this problem, six prisms were necessary. The loss by reflection and absorption in such a prism train would be very great. The brightness of the line itself could not be estimated, since so few of those who had previously observed the line had published the constants of their instruments. Again, it was uncertain from the published observations whether the line was of fairly constant brightness, or varied widely for different eclipses. The prospect of photographing the line with my instrument was not promising, but merited a trial.

C.—A very efficient one-prism spectrograph, for recording the bright-line spectrum of the corona, for recording the continuous and possible dark-line spectrum of the corona, and incidentally the position of the maximum photographic brightness of the continuous spectrum.

D.—The 40-foot camera designed by Professor SCHAEBERLE, and used by him so successfully at the Chile eclipse. He had used the Clark 5-inch photo-heliograph lens. It seemed to him desirable to have a 6-inch lens for this camera, and such a lens was secured by the Observatory. But, when I tested it, defects were found to exist, such that its use was not warranted. There was not time to remedy the defects, and it was decided to use the 5-inch lens. In designing the carriage and track for the movable plate-holder, I followed the simple and practical plans used by Professor SCHAEBERLE. The purpose of this camera was to secure photographs of the inner corona on a large scale, with exposures of moderate length. The Moon's image with it would be nearly $4\frac{5}{8}$ inches in diameter.

E.—The Floyd photographic telescope, of five inches aperture and about sixty-eight inches focal length, mounted on the "polar axis," for recording the general features of the corona. It is a splendid instrument for the purpose.

F.—The Dallmeyer portrait-camera, of 6-inch aperture and 33-inch focus. This is a valuable instrument for recording the outer corona, on a small scale, and for recording any strange object that may happen to be within a few degrees of the Sun. This camera was likewise to be mounted on the polar axis.

G.—An ordinary camera of 11-inch focus and $1\frac{3}{8}$ -inch aperture, the lens giving splendid definition over a very large field. This instrument was intended to supplement in a general way the Dallmeyer lens.

The polar axis, which carried five instruments, was a strong plank box, twelve by fifteen inches in section, and nine feet long, mounted parallel to the Earth's axis, on steel pivots at each end, running in roller bearings. From the middle of one side of the box a strong arm, thoroughly braced in every direction, ran out ten feet, at right angles to the box. On the outer end of the arm a sector of 10-foot radius was fastened. A clock securely mounted very close to the sector released a cord which pressed against the face of the sector, and lowered it at a uniform rate. It will be evident that an astronomical driving-clock applied at the end of a 10-foot arm would give splendidly uniform motion to the instruments attached to the axis. The polar axis formed a packing-case to and from the eclipse.

All the instruments were set up at Mt. Hamilton, and adjusted as far as necessary to test thoroughly all the parts. They were then taken to pieces, and packed as closely as was consistent with safety, along with sextant and chronometer, American ephemerides, thermometers, barometer, a good set of carpenters' and machinists' tools, nails, screws, photographic plates, implements and chemicals, a tent, etc. This whole equipment, in its packing-cases, formed a volume of only eighty-one cubic feet. It was so carefully packed, and so delicately handled *en route* to camp, that it arrived in perfect condition. The transfers of the freight occurred under my personal direction, and it may be said that the freight-handlers at nearly all points were easily persuaded to move the boxes with great care.

I was accompanied by Mrs. CAMPBELL and Miss ROWENA BEANS of San Jose, as volunteer observers traveling at private expense. We left San Francisco October 21, 1897, on the steamship *China* of the Pacific Mail Company. The company kindly offered to stow the instruments in the baggage room of the ship, where they lay at ease in the roughest weather. The twenty-eight-day voyage from San Francisco to Hongkong will always be recalled with the utmost pleasure, in spite of the fact that essentially all the rough weather experienced by us in our trip around the world occurred on the Pacific Ocean. The fine sailing qualities of the *China*, the superior discipline maintained by the captain and officers, the splendid service and comfort provided for all, were more than ever apparent after we had sailed the Indian Ocean, the Red and Mediterranean seas, and the North Atlantic.

As we sailed into Honolulu on a beautifully clear day, the water's surface was a mirror, and all the islands above our horizon were in clear view. We saw nothing on our trip to surpass these islands in natural charm. The extinct volcanoes near the city of Honolulu, known as the Punch Bowl and Diamond Head, were wonderfully interesting, though they were, of course, vastly inferior to the famous living volcano on one of the distant islands.

Our route westward from the Hawaiian Islands lay close to the thin chain of islands which extends nearly to Japan. A few of these islands have been woven into the plots of ROBERT LOUIS STEVENSON'S novels; and many a traveler on these waters has broken a spell of oppressive loneliness by recalling the story of *The Wreckers*, with blessings on the incomparable STEVENSON.

We stopped in Japan as the steamer stopped: one day each at the ports of Yokohama, Kobe, and Nagasaki. Excursions to Tokyo, Osaka, and Mogi were made from those points. Our stay in this fairyland was altogether too short; but the trip was not for pleasure, and we went on with the instruments. The weather in Japan had been perfect; and the absolutely unrivaled sunrise effects on their sacred mountain Fuji on two mornings, the views of the smoking volcano on Vries Island, of the Inland Sea, of the people and their art-treasures, these will remain with us as priceless memories.

The steamer ascended the Yangtse-Kiang River to Woosung, the port of entry for Shanghai. We spent a day in that interesting city,—mostly in the foreign business quarter, it is unnecessary to say. A brief trip into the native walled city was a revelation to me as to how the other half lives, in reckless defiance of all sanitary laws. Our friends living in the modern quarters of Shanghai were ready to do anything for our entertainment, except to accompany us into the native walled city of filth and contagion.

The trip to Hongkong was stormy. We passed through a genuine typhoon, which was not without its dangers. The ship was due to arrive at Hongkong on November 19th, and a P. & O. steamer, which we hoped to sail on to Bombay, was to leave there at noon of the 18th. The *China* entered the harbor on the 18th, at 10 A. M., and, thanks to the assistance of Captain SEABURY, we were at once transferred to the P. & O. steamer *Ancona*, and

started on the second stage of our journey, a seventeen-day trip to Bombay. The instruments were again placed in the baggage-room, and we were the recipients of many favors from the kind and gentlemanly officers. But as to the ship, the discipline, the service, and the food, the less said the better. The only item that was first-class was the price of the passage ticket.

Opportunities for seeing Singapore, Penang, and Colombo very well were afforded by the stopping of the steamer at those ports. Likewise, there was time for a quick trip to Kandy, near the center of the island of Ceylon. The wonderful vegetation of Ceylon was a revelation, even after seeing Honolulu and Singapore.

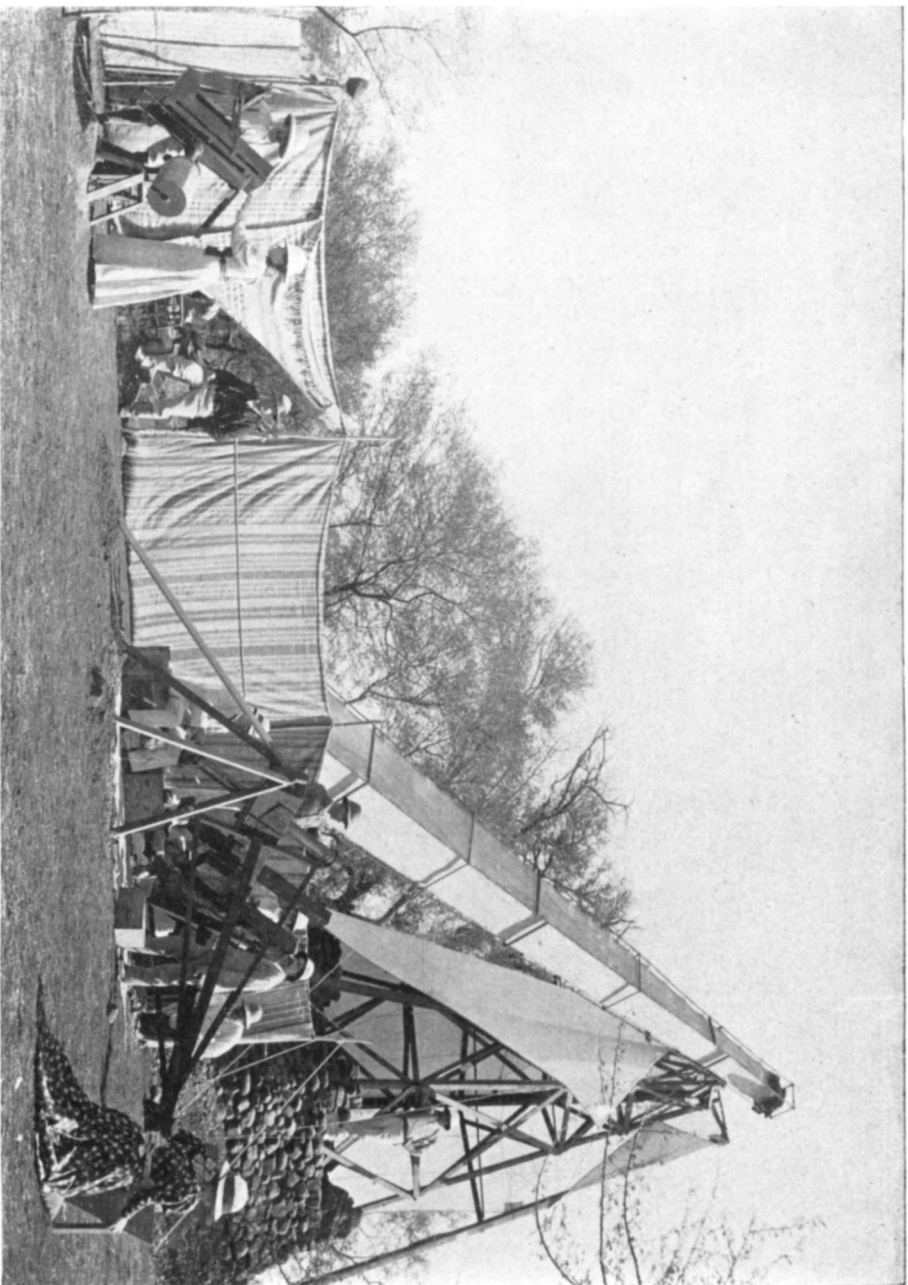
We arrived in Bombay on December 5th, having been forty-five consecutive days on the ocean voyage from San Francisco.

The English Government in India had made every possible preparation to assist the eclipse expeditions, of which ours was the first to arrive. Intending observers had been supplied early in the year with meteorological reports, with large-scale trigonometrical maps covering the regions of possible observing-stations, with data relating to railway transportation, camping-outfits, etc. From these I had decided to locate on the central line of totality a few miles north of Karad, a station about one hundred miles south of Poona. This would bring us in the high eastern foothills of the extensive range of mountains known as the Western Ghats. The contour lines on the maps showed that there would be no trouble in selecting a steep hillside on which to mount the 40-foot camera so that the tube of it would lie near the surface and the lens would require only a short support. This region would be easily accessible from the Southern Mahratta Railway and thence by bullock-cart. Water promised to be plentiful and near at hand. All the mountings of the instruments had therefore been constructed for the latitude of Karad, without a thought that the station could not be occupied.

On arriving at Bombay, I was informed by the government representatives that the bubonic plague was raging at Karad, and that the idea of locating there must be given up, not only on account of the danger to ourselves but because it would be out of the question to retain servants. The small army of servants whom we would have to employ and depend upon would stampede without warning if plague threatened the camp. So it seemed best to select another station. For many reasons the

next best station was about one hundred miles northeast of Karad, where the Great Indian Peninsular Railway crossed the line of totality, near the village Jeur. In company with Professor NAEGAMVALA, the government representative, I visited Jeur as soon as possible. Here we were met by the chief government officer of the district, the Mamlatdar of Karmala, with tongas, two-wheel pony-carts. We examined all the available territory adjoining the only cart-road in the whole region. To my surprise, the region was very flat, and no hills could be found on which to mount the large camera. Water was scarce, since there had been almost no rain for two years. It was in the famine district. The plague was epidemic at Sholapur to the east, and at Poona to the west, with a few sporadic cases just then at a distance of fifteen miles. I decided to locate at a point four miles from the railway station of Jeur, two miles from the central line of totality, and midway between the country villages of Shelgaon and Wangi. As our nearest neighbors would be at Wangi and Shelgaon, two miles in either direction from the camp, it would be possible to quarantine against the plague if it approached uncomfortably near us. The problem of mounting the 40-foot camera in level country,—on a level desert, one might almost say,—at an altitude of 51° , so that it would be secure against wind-vibrations, was not a light matter. It would be easy enough in a country where materials and skilled labor were at command, but in central India it was a formidable problem. The general features of a practicable mounting were planned before deciding to locate in the level country, and the details were filled in later.

The instruments were shipped from Bombay to Jeur by the G. I. P. Ry., in a special car, under special concessions to eclipse-observers, a distance of two hundred and sixteen miles. Bullock-carts were the means of transportation to the camp, four miles from the railway station. The Government not only repaired the road over which the instruments were to be hauled, but employed fifty men to clear the brush and rocks from the camp-ground. A water-carrier (bhisti) and his buffalo were supplied by the Government to bring water to the camp from a well about three-quarters of a mile away, in skin water-bags thrown across the buffalo's back. The Government also supplied us with a "sweeper,"—a low-caste man who is the camp-scavenger,—with two night-watchmen, and with some of our camp furniture from their army stores.



THE LICK OBSERVATORY ECLIPSE STATION - HALF AN HOUR AFTER TOTALITY.

The Mamlatdar of Karmala, the highest official in the Taluka (district of) Karmala, had been instructed by the Bombay Government to look after the wants of the eclipse parties in his district. He was a very able man, practical, and constant in attendance. Our difficulties had a way of dissolving whenever he appeared. But for him we should have suffered many a discomfort in the desert. The Mamlatdar of Karmala is an Indian gentleman, of whose friendship we were and are proud. We shall remember him not only as a most able and faithful official, but as a friend in need.

The instruments, tents, supplies, and servants arrived in camp December 13th. After a day or two spent in pitching tents, establishing camp, etc., I was relieved of all care in regard to our daily wants and comfort, and that was fortunate, since the absence of skilled labor in that region required me to do everything myself that needed any degree of accuracy. The mounting of the 40-foot camera, which promised to be an easy matter in the mountains of Karad, was a genuine problem on the plains at Jeur. The lens at its upper end would be thirty-one feet higher than the plateholder and about thirty-three feet above the observer's platform. I decided to sink the plateholder end into a deep pit—say twelve feet—and thereby bring the lens within twenty feet of the ground. Six or eight native laborers were set to excavating the pit. Their implements were little picks and hoes poorly mounted, with shallow pans to remove the dirt from the pit. The government officials instructed me to pay them two annas—four cents American—each, per day, and thousands of laborers could have been secured at such wages. But time was an object with me, and I paid them three annas each, in consideration of their putting in a long day, of about seven hours. Six cents a day was a princely sum to these fellows, and to receive such wages raised them very high in the estimation of their neighbors. Unconsciously, I was making trouble; for when the other eclipse expeditions located in that vicinity, the laborers demanded from them the same wages that CAMPBELL Sahib was paying. In a couple of weeks, under my hourly admonition to *jildy*,—hurry up,—the men had sunk the 10 x 10-foot pit down to a depth of eight feet. The soil was dry from lack of rain, and almost rock-like, and I decided to go no deeper. I had ordered teak lumber and nails from Poona, a hundred miles away, for the construction of a tower to carry the

lens. The native carpenter whom I hired to assist me was very much in the way, and was kept only three hours. I built a very strong tower, about twelve feet square at the base, fourteen inches square at the top, and twenty-four feet high, with diagonal bracing on the four inclined faces and in the interior. Upon the inclined top a plank was fastened, which projected into the tube and carried the object-glass. The upper end of the tube did not touch the tower or lens-support, but was sustained by a separate wooden pillar. The lower end of the tube was fastened to the firm soil by iron pins, and the whole tube was held in place by wire cables in duplicate. The plate-carriage track was rigidly mounted at the bottom of the pit, quite independent of the tube. The wind could vibrate the tube without jarring either the plate-holder or object-glass. It was necessary to protect the tower from wind-vibrations. The lower end of it was firmly imbedded in a heavy stone wall, filled in with soil, to a height of about nine feet. That left the upper fifteen feet still exposed to the wind. I built a second tower, whose sides were about eighteen inches from the sides of the inner tower, and slightly higher. It was held in position by duplicate cables, so that it could not be blown into contact with the inner tower. A large canvas tent-fly was stretched over the south, east, and north faces of the outer tower, extending from above the lens to below the top of the stone wall. As the prevailing winds were from the southeast and east, the lens needed no further protection. On several days, just prior to the eclipse, fairly strong winds were blowing at the time when the Sun's image swept across the plate-holder, but not the slightest vibration of the lens could be detected.

The other eight instruments were mounted rapidly, though many changes and additions were made, involving the use, I believe, of every tool taken with me. The adjustments to focus, etc., were completed on January 16th, six days before the eclipse date.

As stated above, I was trusting to volunteer observers to man the instruments. When I first arrived at Bombay, many of the government officials said it would be impossible to secure volunteer assistants from among the army, navy, or civil officers, as they were not accustomed to such service. We had not been in Bombay many days, however, before offers came in abundance. Between twenty-five and thirty offers were received from men of thorough scientific training. The total number of observers

required to manage the instruments was twelve, or nine in addition to the three who had gone out from California. The abundance of volunteers made a choice almost embarrassing. I was even obliged to decline offers from two very able and enthusiastic amateur astronomers residing in India.

In addition to Mrs. CAMPBELL and Miss BEANS, I was assisted by Captain HENRY L. FLEET, Royal Navy, in charge of Her Majesty's marine forces in the Bombay harbor; by the commanders of three of his torpedo-boats, Lieutenant KINEHAN, R. N., Lieutenant MANSERGH, R. N., and Lieutenant CORBETT, R. N.; by Engineer GARWOOD, R. N.; by Major BOILEAU, Royal Engineer; by the Rev. J. E. ABBOTT, who had been a student under Professor YOUNG at Dartmouth College; by the United States consul at Bombay, Major S. COMFORT, and Mrs. COMFORT.

The volunteer observers arrived in camp from January 17th to 20th. All of them were assigned to responsible positions, and it was a pleasure to drill them in the details of the programme. The final drill occurred the evening of January 21st, with every observer perfectly at ease in his assigned work.

On the 21st, all the clock cords were carefully examined, and some of them renewed. The cameras, plate-holders, etc., were tested for leaks which might let in the light, and all the adjustments were verified. Some mysterious forces had disturbed the adjustments of the 40-foot camera plate-carriage tracks in the bottom of the pit, and the very important clock which rotated the polar axis, on the night of January 20th. Fortunately, the disturbances were so marked that they were noticed by me just before beginning the rehearsal on the afternoon of the 21st. As the Sun passed through the region of the sky which the eclipsed Sun would occupy the following day, I had time enough, and just enough, to readjust these very essential parts. I had not been aware that animals came around the camp at all, but, to guard against a similar occurrence, on the night of the 21st, Captain FLEET suggested that he and the other observers should do guard duty at the instruments throughout the night. Every one entered into the plan with enthusiasm, and the instruments were all right on the morning of the eclipse.

The plate-holders were filled the night of the 21st, most of the plates being "backed" with black liquid backing.

The final examination of the instruments was made the morn-

ing of the eclipse, to see that no cobwebs or dust could interfere with the proper passage of the light. The wind-breaks of floor-rugs, on bamboo poles, were put up by the naval officers. Sextant observations of the Sun for determining the correction to the chronometer were made and reduced, and the chronometer times for the beginning and ending of totality were computed. Our preparations were completed about two hours before totality. Although there were one or two thousand excursionists at Jeur, from Bombay, Madras, and elsewhere, they were not allowed by the government officials to come near the eclipse camps, nor were the natives allowed to leave their villages to come to the camp, so that our surroundings were favorable. We were in camp seven weeks, and I should say the eclipse day was the most perfect of all. There had been more or less wind on previous days, but the 22d was perfectly calm. The atmospheric conditions were all that could be wished for. The observers took their places a few minutes before the time of totality. Captain FLEET and Engineer GARWOOD in the 40-foot camera; Lieutenant CORBETT at the chronometer, just outside the large camera, and near the polar axis; Lieutenant KINEHAN and Miss BEANS at the Pierson camera; Lieutenant MANSERGH and Major COMFORT at the Floyd telescope; Mrs. COMFORT at the 11-inch camera; Mr. ABBOTT at the 6-prism spectrograph; Major BOILEAU, at the grating spectrograph; and Mrs. CAMPBELL and myself at the two spectrographs on the equatorial mounting. There was no nervousness discoverable in the party. Lieutenant CORBETT was to give the signal at twenty seconds before totality, for Major BOILEAU and myself to start the moving plate-holders of the three spectrographs, to record the varying spectrum of the Sun's edge, as the edge was gradually covered by the Moon. Captain FLEET, in the 40-foot camera, was to give the signal "Go" at the instant when the corona flashed out at the vanishing-point of the crescent Sun, at which signal the chronometer count was to begin, along with the programmes of the four cameras and the two additional spectrographs. The programme of signals and exposures was carried out by the observers without nervousness or excitement, as well as if they had been professional observers of eclipses. The spirit of the observers may be illustrated by one or two circumstances. I had constructed a small annex tent in the pit of the 40-foot camera, into which the observers, Captain FLEET and Mr. GARWOOD, could go and look a few seconds at the

corona. They refused to do so, and did not see the corona except as it was photographing on the 14 x 17-inch plate. Lieutenant CORBETT was asked to keep his eye on the chronometer during the first minute, and then feel free to count by sound as long as he cared to view the corona during the second minute. He did not take his eye off the second-hand during the whole of totality. Other instances of sacrifice of self to the success of the expedition could be mentioned. The same noble qualities came out on the days preceding the eclipse, and with such assistants I laughed at Failure. It is plain that no astronomer was ever more ably assisted by volunteer observers.

The eclipse began within a half-second of the computed time, and ended in the same way, lasting $1^m 59\frac{1}{2}^s$. The duration, computed from the American Ephemeris, was $1^m 59^s$; and from the English Nautical Almanac, was $2^m 5^s$.

It is impossible to describe the beauty of the Sun's surroundings. The corona was exquisite, more beautiful by far than anything else we saw in a journey around the world. It is well worth a journey to remote regions of the Earth to see.

The first illustration (Frontispiece) is a general view of the eclipse camp; and the second (page 134), taken a few minutes after the eclipse, shows the observers at their instruments, except those who had been in the 40-foot camera.

After the eclipse, the development of the plates was taken up. Previous experiments had shown that the chemical formulæ used at home could not be used in India. The formulæ were experimented with until one was obtained which gave good results. The weather in camp was very hot in the daytime, but grew rapidly colder at night, reaching a minimum about sunrise. The extremes were such as I had never experienced before. When the day temperature remains for hours at 92° or 93° Fahr., a night temperature of 42° seems bitterly cold. Yet this range of fifty degrees occurred several times while we were in camp. The heat was intense during the week following the eclipse, and greatly affected the photographic development. With a dark room composed of one tent inside another tent, it was necessary to wait until the atmosphere cooled down—from 1 A. M. till sunrise, and all the plates were developed in those hours. The negatives from all the instruments came out almost exactly as they were expected to, and the expedition was a success.

The instruments were quickly dismounted and repacked, the

photographs were packed with special care, and the tents and camp furniture were made ready for shipping. I can still see that long line of bullock-carts moving slowly out of our camp to the station. Our life there was so intense, among a people so strange and so interesting, that the *individual incidents* of the seven-weeks' camping experiences in central India will remain as vividly with us as the general effect of the whole.

When the instruments and photographs were safely stored in the specie-room of the Steamship *Socotra* at Bombay, *en route* to Hongkong, the eclipse was over, and we were ready to enjoy the wonders of Delhi, Agra, the Himalayas,—but that is not an astronomical story.

Our route homeward brought us *via* the observatories at Cairo, Rome, Florence, Milan, Nice, Paris, Greenwich, Tulse Hill, Kensington, Cambridge, Oxford, and Williams Bay, where we were the recipients of many kindnesses from busy astronomers.

I cannot close this account without a grateful acknowledgment of the services rendered to the expedition by the United States consul at Bombay, Major COMFORT. I know that our expedition was continually held in mind by him, both as the representative of our government, and as our valued friend. We were almost daily recipients of his assistance. The continual kindness shown us by Major and Mrs. COMFORT, by Captain and Mrs. FLEET, and by many others, contributed both to the success of the expedition, and to the pleasure of our visit in that wonderful country.

Three other eclipse parties were encamped near our station: the Japanese Government party from Tokyo; the Indian party from the Poona College of Science, under Professor K. D. NAEGAMVALA; and Professor BURCKHALTER, from the Chabot Observatory, in charge of the PIERSON expedition. Professor BURCKHALTER was just as enthusiastic in India as he is at home. Interchanges of visits between our camps were frequent, and gave us great pleasure. We were glad of his success, not only because he was our countryman, but because success was deserved.